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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/944,981	08/30/2001	Kie Y. Ahn	1303.021US1	1912

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EXAMINER	
LINDSAY JR, WALTER LEE	

ART UNIT	PAPER NUMBER
2812	

DATE MAILED: 03/18/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/944,981	AHN ET AL.	
	Examiner	Art Unit	
	Walter L. Lindsay, Jr.	2812	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10 November 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-29,54-60 and 67-69* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *9-13 and 67-69* is/are allowed.

6)☒ Claim(s) *1-7,9-20,22-28,54-56 and 58-60* is/are rejected.

7)☒ Claim(s) *8,21,29 and 57* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-7, 14-20, 22-28, 54-56 and 58-60 are rejected under 35 U.S.C. 103(a) as being unpatentable over Maiti et al U.S. Patent No. 6,020,024 in view of Dalal et al U.S. Patent No. 4,797,593.

The main subject of the present invention is the formation of a rare earth metal that is deposited by evaporation and then oxidized. The combination of Maiti and Dalal are applied and cover these issues.

Maiti discloses the use of a metal oxide layer as a gate layer. FIG. 2 illustrates the formation of a metal oxide gate layer 16. In one embodiment, the metal oxide gate dielectric layer 16 is formed by the deposition 18 of a metal film followed by an oxidizing ambient. In another embodiment, the environment 18 would be a chemical vapor deposition (CVD) of a metal oxide followed by an oxygen anneal to reduce oxygen vacancies in the metal oxide film. Such CVD metal oxide depositions or metal sputtering followed by O.sub.2 anneal would include the formation of tantalum pentoxide, titanium dioxide (TiO.sub.2), yttrium oxide (Y.sub.2 O.sub.3), niobium oxide (Nb.sub.2 O.sub.5), zirconium oxide (ZrO.sub.2), hafnium oxide (HfO.sub.2), lead zirconium titanate (PZT), barium strontium titanate (BST), calcium oxide (CaO),

beryllium oxide (BeO), magnesium oxide (MgO), and strontium bismuth titanate (SBT). In addition to the deposition of metal oxide gate dielectric layer using CVD, it is possible to deposit a metal layer by sputtering and subsequently perform an oxidation step on the deposited layer and also perform CVD of a metallic oxide to form a composite metal layer. In this approach, any of the previously listed metals, tantalum, titanium, yttrium, niobium, zirconium or hafnium, could conceivably be deposited in metal form forming a layer and subsequently oxidized during an annealing step (col. 3 lines 30-52).
The metal oxide gate layer 16 will be a high-k dielectric layer. Typical permittivity values, depending upon the metal or alloy used to form the oxide layer 16, will be in the range of k=7.0 through 1500. Where tantalum pentoxide is used, a permittivity k or epsilon of approximately 25 is obtained. Therefore, where tantalum pentoxide forms the metal oxide gate layer, it can have a thickness of approximately 100 angstroms and have the same equivalent SiO.sub.2 thickness of 20 angstroms for a conventional gate oxide layer. The 100 angstroms thickness of the tantalum pentoxide gate would reduce the amount of leakage current across the gate dielectric structure while still improving the overall performance of the semiconductor structure by maintaining or reducing the effective gate oxide thickness (EOT). Following the formation of the high-k dielectric layer 16, an oxidizing ($\bar{O}$.sub.2) anneal step, or other anneal process for improving the molecular quality, can be performed in order to reduce defects in of the dielectric layer (col. 3 line 64 –col. 4 line 14).

Dalal discloses the formation of a tantalum layer formed by an evaporation process.

Returning to Fig. 1E, a layer of tantalum 28 is blanket-deposited atop the substrate and the lift-off mask. To achieve a low-barrier-height contact, the tantalum deposition process also must conform to an exacting procedure. The deposition is best accomplished in an E-beam evaporation source such as is marketed by the Airco-Temescal Corp. as their Model FC1800 System. Similar types of evaporation systems are available from other vendors. The maximum pressure in the evaporation chamber during the process is $2.5x10^{-6}$ torr, with the initial pressure in the chamber being less than $4x10^{-7}$ torr. The maximum temperature of the substrate is 200°C. The importance of the pressure lies in the amount of moisture, hydrocarbon and other gaseous contaminants present in the chamber. The higher the pressure, the greater the moisture and contaminants, which cause the tantalum to oxidize slightly, resulting in a barrier height of greater than 0.5 electron volts. If a barrier light of this value is acceptable, then the pressure in the chamber is of less significance and routine processes may be used. The deposition process, which occurs at a rate of around 2 Å per second, continues until a thickness of 600 Å∓ 150 Å is achieved. The tantalum which is formed using this method is body-centered-cubic (BCC).

Given the teaching of the references, it would have been obvious to determine the optimum thickness, temperature as well as condition of delivery of the layers involved. See In re Aller, Lacey and Hall (10 USPQ 233-237) It is not inventive to discover optimum or workable ranges by routine experimentation. Note that the specification contains no disclosure of either the critical nature of the claimed ranges or any unexpected results arising therefrom. Where patentability is said to be based upon

particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 f.2d 1575,1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

3. Maiti et al. (6,020,024) teaches the formation of metal gate oxides formed on a transistor. The method used in Maiti et al. calls for the **sputtering** of a metal layer followed by an O_2 anneal (col. 3 lines 30-52). The Applicants independent claims follow the general procedure of first forming a metal layer and then following it by an O_2 anneal however, the formation of the metal layer is carried out by **evaporation deposition.** Dalal et al. (4,215,156) suggest that **E-beam evaporation** be performed to form a tantalum layer upon a transistor (col. 4 lines 30-55). Dalal et al. also disclose that a **RF sputter** can be performed under the same initial conditions (col. 4 lines 56-60). In light of what is claimed the only deficiency in Maiti et al. is the fact the metal layer is deposited by an evaporation deposition, this is remedied by the introduction of E-beam evaporation of Dalal et al. It is viewed by the examiner that in using the teachings of Dalal et al. in the primary reference of Maiti et al. by replacing the sputtering of the metal layer with E-beam evaporation Maiti et al. still forms the same structure without causing it to be destroyed and reads on the applicants claims.

In view of this disclosure, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the knowledge of Dalal that rare earth metals can be deposited by evaporation in the primary reference of Maiti to deposit the metal oxide gate layer in order to gain the advantage of the fact that a metal oxide layer

can be formed to a thickness greater than a silicon oxide layer but maintains the advantages of a thinner layer of silicon oxide.

4. Claims 9-13 and 67-69 are allowed.

5. Claims 8, 21, 29 and 57 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is an examiner's statement of reasons for allowance: the prior art, either singly or in combination fails to anticipate or render obvious, the limitations of:

The process of evaporation combined with the oxidizing the metal layer in a krypton(Kr)/oxygen (O_2) mixed plasma process to form a metal oxide layer on the body region.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Walter L. Lindsay, Jr. whose telephone number is (571) 272-1674. The examiner can normally be reached on Monday-Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John F Niebling can be reached on (571) 272-1679. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

WLL
March 11, 2004

John F. Niebling
Supervisory Patent Examiner
Technology Center 2800